Modicon TSX Momentum

ControlNet Communication Adapter

User Guide

870 USE 007 00

Rev.: 1.0

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GROUPE SCHNEIDER

■ Merlin Gerin ■ Modicon ■ Square D ■ Telemecanique

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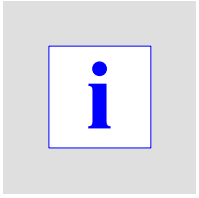
Info



Caution
The relevant regulations must be observed for control applicatons involving safety requirements.
For reasons of safety and to ensure compliance with documented system data, repairs to components should be performed only by the manufacturer.

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Terminology

Note
This symbol emphasizes very important facts.

Caution
This symbol refers to frequently appearing error sources.

Warning
This symbol points to sources of danger that may cause financial and health damages or may have other aggravating consequences.

Expert
This symbol is used when a more detailed information is given, which is intended exclusively for experts (special training required). Skipping this information does not interfere with understanding the publication and does not restrict standard application of the product.

Tip
This symbol is used for Tips & Tricks.

Example This symbol emphasizes the begining of an example.

▶ **Proceed as follows:**
This marks the beginning of a series of applications that must execute in order to achieve a certain product function.

Related Documents:
This symbol indicates manuals or other sources which elaborate on the addressed topic in more detail.

Employed Symbols and Abbreviations

The notation applied to numerical values conforms to international practice, as well as a SI (Système International d' Unités) sanctioned representation. This notational format requires a space between hundreds and thousands, and the use of the decimal point (For example: 12 345.67).

Related Documentation

Title	Order–No.
I/O Module Bases for TSX Momentum, User Manual	870 USE 002 00

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The ControlNet Network

1

- Key Features
- Overview
- Media
- Configuration Data
- Product Classes
- Interfaces

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1.1 ControlNet Key Features

The ControlNet Key features are:

- Real–time I/O data (Deterministic, repeatable)
- Controller to Controller interlocking data (Deterministic, repeatable)
- Controller to Controller messaging data (As required and time allows)
- Program upload/download data (As required and time allows)

1.2 Overview to the ControlNet Network

Physical Layer
- 5 Mbits/s
- 99 Devices per Network
- Coax and fiber media
- Media Redundancy

Data Link Layer
- Scheduled services (Control and I/O)
- Unscheduled services (Peer to Peer Messaging, Programming)
- Network maintenance services

Application Layer (Peer to Peer)
- Producer /Consumer (multicast) for I/O updates (Deterministic and Repeatable)
- Client Server for Messaging and Programming
- Up to 512 Bytes of data

1.3 Media

- ControlNet is designed to support multiple media types including coax and fiber optics by the network using special repeaters.
- ControlNet supports a passive bus topology using coax cable media and coax tap devices:
- Coax connectors used are BNC type
  - Support quick connection
  - Easy to install
- Multiple versions already certified for special applications

1.4 Configuration Data

Network update time:	
NUT	Network update time: Base time interval at which the network restart the scheduled service (2 ... 100ms)
Maximum number of nodes:	
SMAX	Highest network address of a node that can use scheduled service (0 ... 99)
UMAX	Highest network address of a node that can use unscheduled service (SMAX–99)
How much data to exchange:	
	The length of each message has to be defined
How often each node would like to send and receive scheduled data:	
RPI	Requested Packet Interval, says how often each node (application) would like to send or receive data
How often each node sends and receives scheduled data:	
API	Actual Packet Interval, says how often each node (application) sends or receives data

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1.5 Product classes

The following gives an overview of the variety of different ControlNet nodes: They can be assigned to three different product classes:

1.5.1 Explicit messaging

- These nodes can be
  Programming devices, configuration tools, operator interfaces
- They handle
  Unscheduled message connections and data

1.5.2 Adapter

- These nodes can be
  Racks of I/O, weld controllers, robots, operator interfaces
- It produces and consumes scheduled (real–time) data but cannot originate the process (establish the connection)
- It may originate, produce and consume unscheduled (non–real–time) data to/from all other classes

The product class of the ControlNet Communication Adapter 170 LNT 810 00 is adapter.

1.5.3 Scanner

- These nodes can be
  PLC's, PC, based controllers, weld controllers, robots, anything that need originate and control the transfer of real time data
- They handle
  Scheduled and unscheduled data and unscheduled connections and originates the setup of real–time data transfers (opening connections)

1.6 Interfaces

ControlNet nodes provide two different interfaces:

- Coax media interface for connection to the ControlNet Network
- Network access port interface (NAP) for programming and test devices

To connect the node to the network special TAPs are required. Refer to the specification in section 4.4 on page 23 for further details.

1.7 Electronic Module Description Disk (HWX File)

An HWX file disk is included with this guidebook. It supplies the ControlNet Parameters for setup of each type of Momentum I/O base.

README.TXT File
The disk contains a README.TXT file in a standard text (ASCII) format, which can be viewed and printed with any standard word processor or text editor program. The README.TXT file describes the filename conventions used on the HWX disk and provides detailed information on installing and deinstalling procedure.

HWX File Updates
Updated HWX files are available for downloading from the Customer Support areas of the Schneider Automation Web Site and Bulletin Board service.

Table 1 HWX File Download Sources

Source	How to Access	How to Locate HWX File
Web Site	http://www.modicon.com	path: Support/Training –> Files Fixes and Updates –> Software for SA Products –> Communication Products –> ControlNet

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Network Configuration

2

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What the customer must do
The customer configures the network by using the tool RSNetWorx. The configuration can be done on–line or off–line by providing the following:

- Network Update Time (NUT)
- Maximum Scheduled Address
- Maximum Unscheduled Address
- Media Redundancy
- How much data the nodes would like to exchange
- How often each node (application) would like to send or receive scheduled data (Requested packet interval RPI)

For details refer to section 5.1 beginning on page 28.

What RSNetWorx does then
In order to optimize the data transmition RSNetWorx does the following (under the hood): It reserves enough unscheduled bandwidth to support one maximum length frame and checks the following:

- Is enough scheduled bandwidth available to support the configuration? If not, enlarge the network update time (NUT)
- Shows percent of the scheduled bandwidth that has been reserved
- Shows the actual rate the data will be sent (Actual packet interval API)

Each node has a set of unique Device Configuration Parameters that are required before it can transmit scheduled data.

- Device Configuration Parameters are not required to transmit unscheduled data
- Parameters include: scheduled frame length, serial number, revision, etc.

A keeper (CMM) function contained within a high–end node has to ensure the non–volatile storage of network parameters.

Interface to Momentum I/O

3

- Input Data
- Output Data

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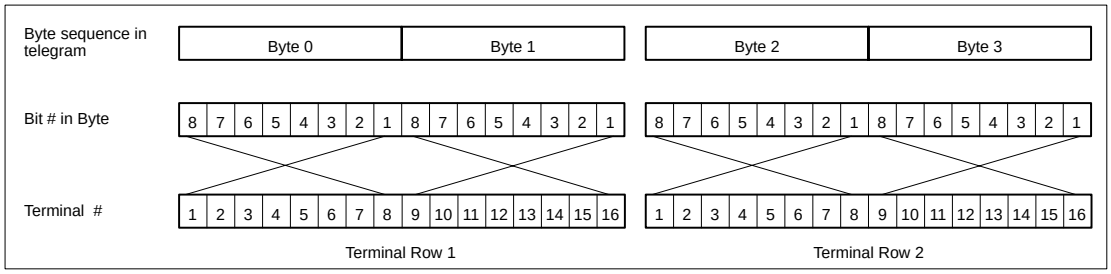
3.1 Input Data (I/O Base to ControlNet)

Input data includes both process data and diagnostic data. The length of the process data is module dependent. Refer to the I/O bases module descriptions for more details (870 USE 002 00).

The input data of an I/O base are mapped into an input data block which is part of a ControlNet data telegram. The bits in the input data block are arranged bytewise along the following way:

Word 0	Low Byte (Byte 0)	Process Data
	High Byte (Byte 1)	
Word 1	Low Byte (Byte 2)	
	High Byte (Byte 3)	
...	...	
Word n	Low Byte (Byte 2n)	
	High Byte (Byte 2n+1)	
Diagnostics	Low Byte	Diagnostic Data
	High Byte	

Within the bus, the I/O bits are mapped as follows (example for ADI 350 00):



Diagnostics
Diagnostic information is always placed at the end of the data block. The configuration tool enables suppressing the transfer of diagnostic information. This improves the network performance and saves memory in the PLC.

High Byte	Bit 7 ... 0	all I/O bases	Firmware information (coded).
Low Byte	Bit 7 ... 3		Reserved.
	Bit 2 = 1	I/O bases using parameters	Parameter invalid. I/O base has got invalid parameters.
	Bit 1 = 1	(analog I/O bases, counters, ...)	Not ready. I/O base is not operational. If bit 1 is zero all I/O values are valid.
	Bit 0 = 1	most of the I/O bases	I/O Error (detected on the I/O base).

The meaning of the I/O error is module dependent (e.g. overload and/or missing output voltage, ...). Refer to the I/O bases module descriptions for more details (870 USE 002 00).

In many applications the evaluation of the diagnostic information is important. In all other cases you can suppress the transfer of the diagnostic information.

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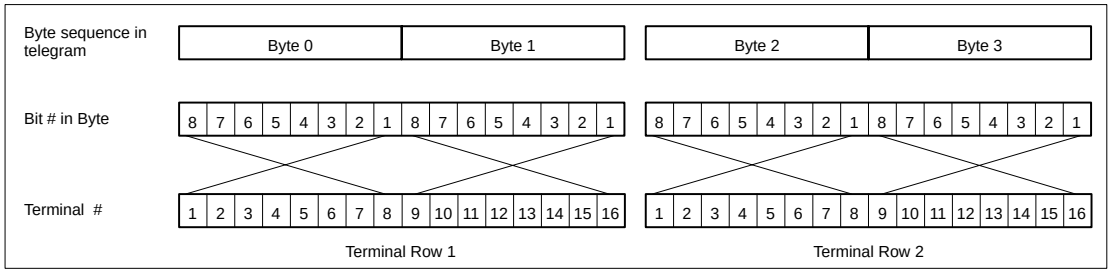
3.2 Output Data (ControlNet to I/O Base)

Output data is always process data. For some modules (analog, ...) parameters are included, too. The length of the output data is module dependent.

The output data for the I/O base are sent by a ControlNet telegram containing an output data block. The bits of the output data block are arranged bytewise in the I/O base along the following way:

Word 0	Low Byte (Byte 0)	
	High Byte (Byte 1)	
Word 1	Low Byte (Byte 2)	
	High Byte (Byte 3)	Process Data
...	...	
Word n	Low Byte (Byte 2n)	
	High Byte (Byte 2n+1)	

The assiggnmet of the bits to the I/O bases terminals is module dependent. Refer to the I/O bases module descriptions for more details (870 USE 002 00). In the following an example for the ADO 350 00 is given:



Parameters
Parameter transfer is usual for analog I/O bases. Parameters are always placed at the beginning of the data block and are cyclically transferred with the process data.

The I/O base checks the parameters for validity. If invalid parameters are detected, bit 2 in the diagnostics low byte is set to 1. The I/O base ignores the invalid parameters and keeps running with the old ones.

Hardware Description
170 LNT 810 00

4

The following topics will be reviewed in this chapter:

- Communication Adapter Overview
- Configuration
- LED Indicators
- Technical Specifications

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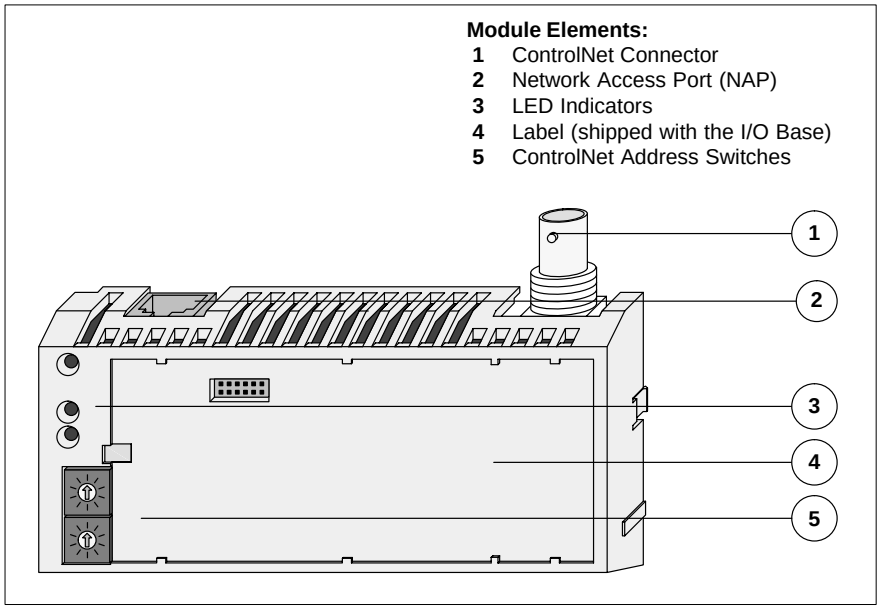
4.1 Communication Adapter Overview

The 170 LNT 810 00 ControlNet Communication Adapter provides the communication interface between Momentum I/O base and the the ControlNet network. It can be operated with any TSX Momentum I/O base.

Basic Data

Module Type	ControlNet Communication Adapter
Power Supply	5 VDC / 250 mA (from I/O Base)
Transfer Rate	5 MBit/s
Bus length	Dependent on nodes per segment



4.2 Configuration

4.2.1 Address Settings

ControlNet nodes are identified by addresses assigned to them by the user. Each node must have a unique address in the range 1 ... 99. Duplicate addresses are not allowed. Addresses are assigned logically and are not dependent upon the physical locations of the node devices.

The address setting on the adapter's front panel switches must correspond to the address defined for that adapter in the application program to ensure that messages are sent and received properly at the correct nodes across the network.

Figure 1 Setting the ControlNet Address to 36

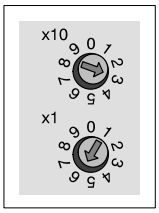


Table 2 Possible ControlNet Addresses

ControlNet address	Upper rotary switch (x 10)	Lower rotary switch (x 1)
1 ... 9	0	1 ... 9
10 ... 19	1	0 ... 9
20 ... 29	2	0 ... 9
30 ... 39	3	0 ... 9
40 ... 49	4	0 ... 9
50 ... 59	5	0 ... 9
60 ... 69	6	0 ... 9
70 ... 79	7	0 ... 9
80 ... 89	8	0 ... 9
90 ... 99	9	0 ... 9

Caution
Do not install any adapter unless you have set its network address for your application. See your network administrator to get the node address for each adapter.

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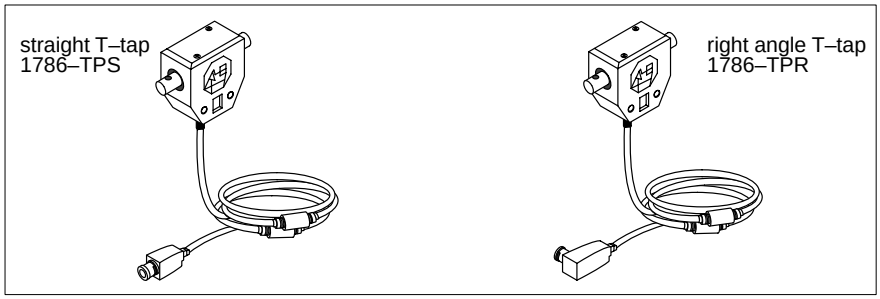
4.2.2 Connecting the ControlNet

To connect the ControlNet, you will need drop cables with standard lengths. The cable proposed by Schneider Automation is:

Description	**Allen Bradley Part No.**
ControlNet drop cable (straight T–tap)	1786 – TPS
ControlNet drop cable (rihgt angle T–tap)	1786 – TPR
Network Access Port (NAP) cable	1786 – CP



For further information on cables and accessories refer to the ControlNet homepage http://www.controlnet.org or to the Allen Bradley documentation.

4.2.3 Network Access Port (NAP)

The Network Access Port is used for diagnostic purposes. It also provides programming capability on the ControlNet network. A programming terminal connected to this port is counted as a node and must have a unique address.

☞ **Note**
Do not connect a PC to a Tap when you have already a connection to the Network Access Port.

Table 3 Pin Assignment of the Network Access Port

Pin	Connection
1	GND
2	not connected
3	TXP
4	TXN
5	RXN
6	RXP
7	not connected
8	GND

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4.3 LED Indicators

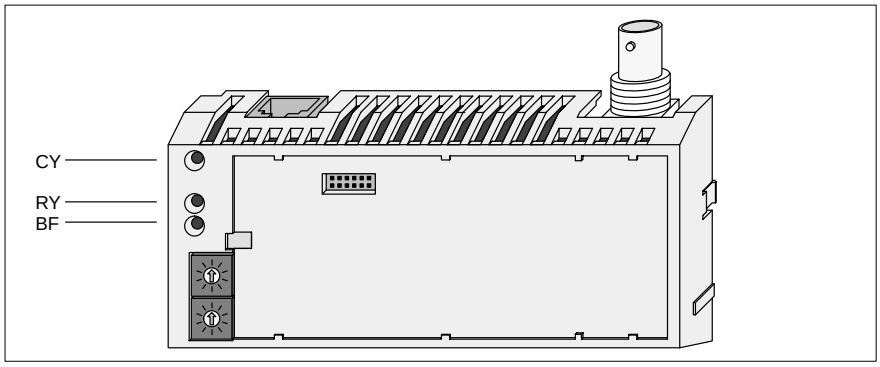

Table 4 LED CY (Microcontroller ready)

Indicator State	Status
Green (steady)	Normal operation: power is present from I/O base.
Green (flashing)	Fault on the adapter: 14 flashes: Connection time out or no connection configured (no data exchange) 15 flashes: PLC not running, outputs set to zero Other flashes: fatal error
Off	Unrecoverable fault or adapter is not receiving power from I/O base.

Table 5 Module/Network Status Indicator RY (ready)

Indicator State	Status
Green (steady)	Normal operation: adapter is communicating on network.
Off	Adapter is not receiving power from I/O base, or adapter does not detect any network traffic.
Green (flashing)	Adapter does not have an established network connection.

Table 6 Module/Network Status Indicator BF (bus fault)

Indicator State	Status
Red (steady)	I/O has unrecoverable fault.
Red (flashing)	I/O has fault.
Off	No errors detected.

4.4 Technical Specifications

General	
Power consumption	250 mA at 5 V (supplied by the I/O base)
Power dissipation	1.2 W (typ.)
Potential Isolation	
ControlNet Connector	ATI to bus (transformer coupled bus isolation)
Network Access Port (NAP)	Not Isolated
Error Detection	
Data Exchange	3 LEDs for bus errors and internal errors (page 22), 1 diagnostic word in the input data block (page 14)

ControlNet Data Interface	
Transfer mode	half–duplex
Communication rate	5 MBit/s
Number of Nodes (Devices)	up to 99 devices (48 w/o repeater)
Media	Coax
Connector	BNC connector, supplied with the TAP
Bus length	Up to 250 m with 48 nodes, up to 1000 m with 2 nodes Formula: 1000 m – 16.3 m x (# of taps – 2) 3280 ft – 53.4 ft x (# of taps – 2)

Ordering Details	
Description	**Part No.**
Communication Adapter for ControlNet	170 LNT 810 00
Set of Labels	Corresponding to the I/O base
Further Accessories (TAPs, cable, ...)	refer to section 4.2.2 on page 20
*) shipped with this book	

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Getting started with ControlNet

5

- ControlNet configuration by RS NetWorx
- Limitations for Mapping Data

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5.1 ControlNet Configuration by RS NetWorx

To use ControlNet a network configuration has to be made. This configuration has to be downloaded to the ControlNet keeper node (PLC).

Therefore the following steps are required:

Step 1 Configuration of the Communication Driver (RS Linx – KTCX PC–Card)

Step 2 Adaptation of the General Network Properties

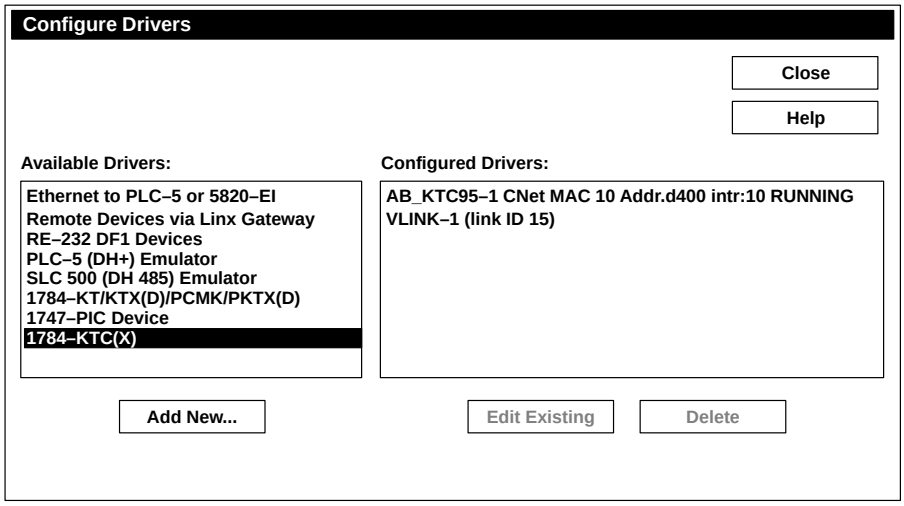
Step 3 Data Mapping at the PLC

Step 4 Download of the Network Configuration to the PLC

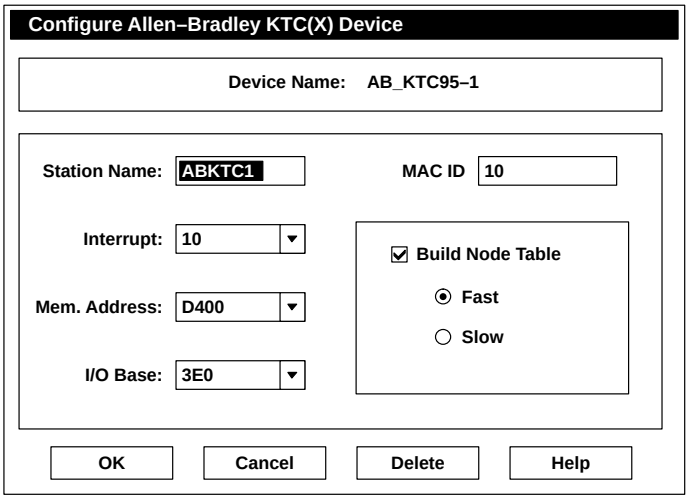
5.1.1 Configuration of the Communication Driver

This step is only necessary when you have no PC–card installed up to now. For more information refer to the documentation shipped with the PC–card.

Start RS Linx, select menu Communications, item Configure Drivers.



Insert the new PC–Card by ”Add New”, adapt the driver parameter by selecting your card by the mouse cursor and pressing the left mouse button. By ”Edit Existing” you will get the following screen:



Mem. Address, I/O base are selected by dip switches at the PC card and have to be taken over. If you work on Windows 95, it’s recommended to select ”Build Node Table” – ”Fast”. To finalize the driver configuration confirm the data by ”Ok”. Now you can close all windows and leave RS Linx.

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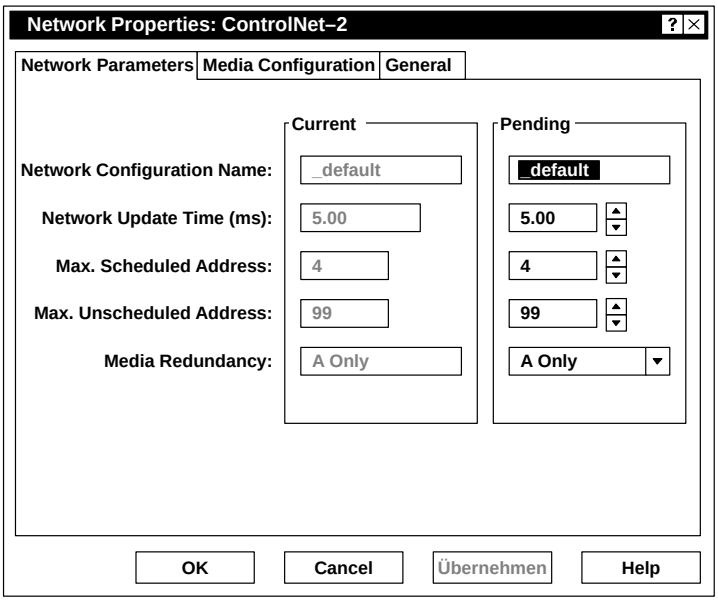
5.1.2 Adaptation of the general Network properties

For the network configuration you have to use RS NetWorx. A configuration for the whole network is made and downloaded to the PLC with the ControlNet station number 1. This PLC works as the network keeper and is required always to initialize the network.

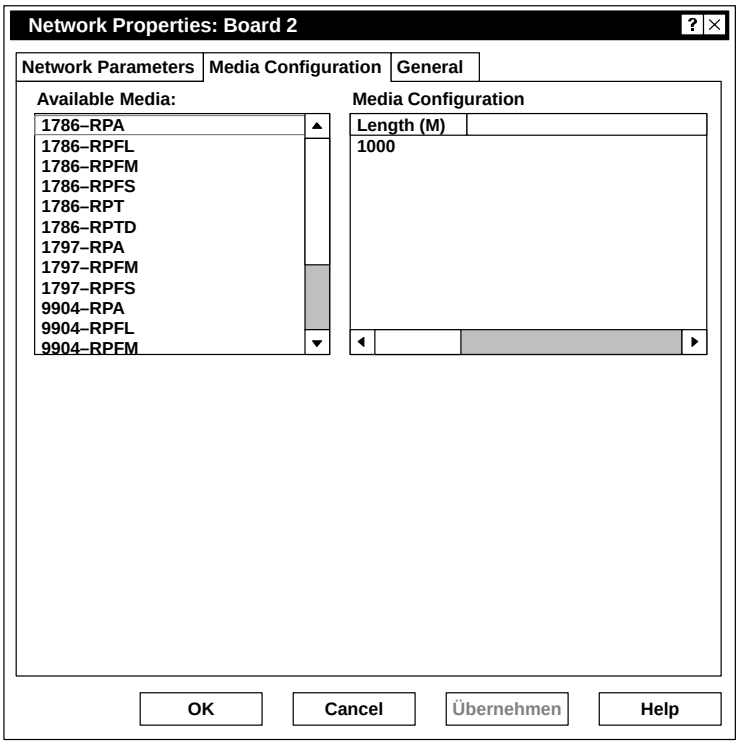
Selecting the menu ”Network”, ”Properties” you will get the following window:



You can set the following Network Parameters:

Network Configuration Name	Name for your ControlNet network configuration
Network Update Time	Time you want the Network to update your data.
Max. Scheduled Address	Highest node address requested to exchange scheduled data.
Max. Unscheduled Address	Highest node address requested to exchange unscheduled data. Note: All scheduled connections need unscheduled data to get initialized.
Media Redundancy	Select ’A Only’ for networks with Momentum I/O bases.

In the window Media Configuration you can select your Network Media



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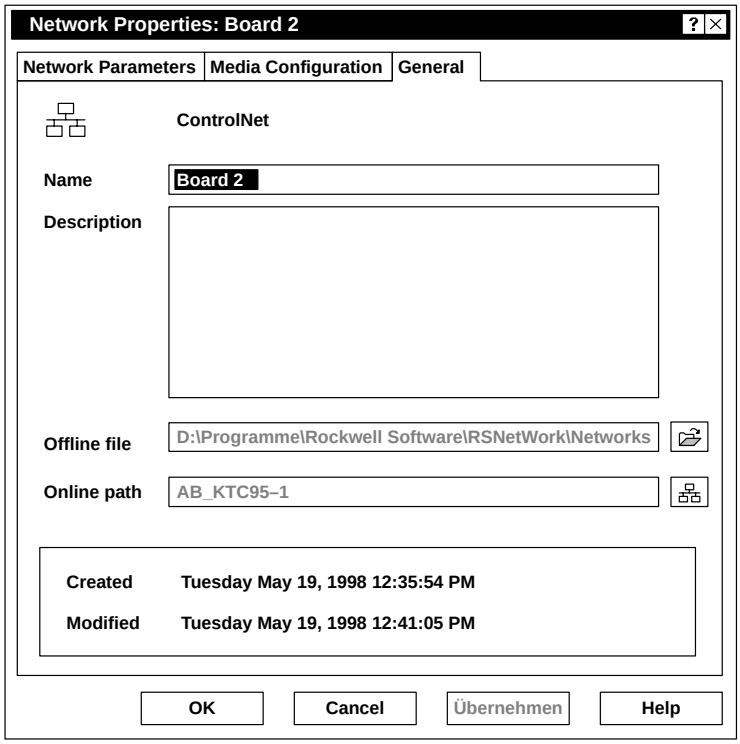
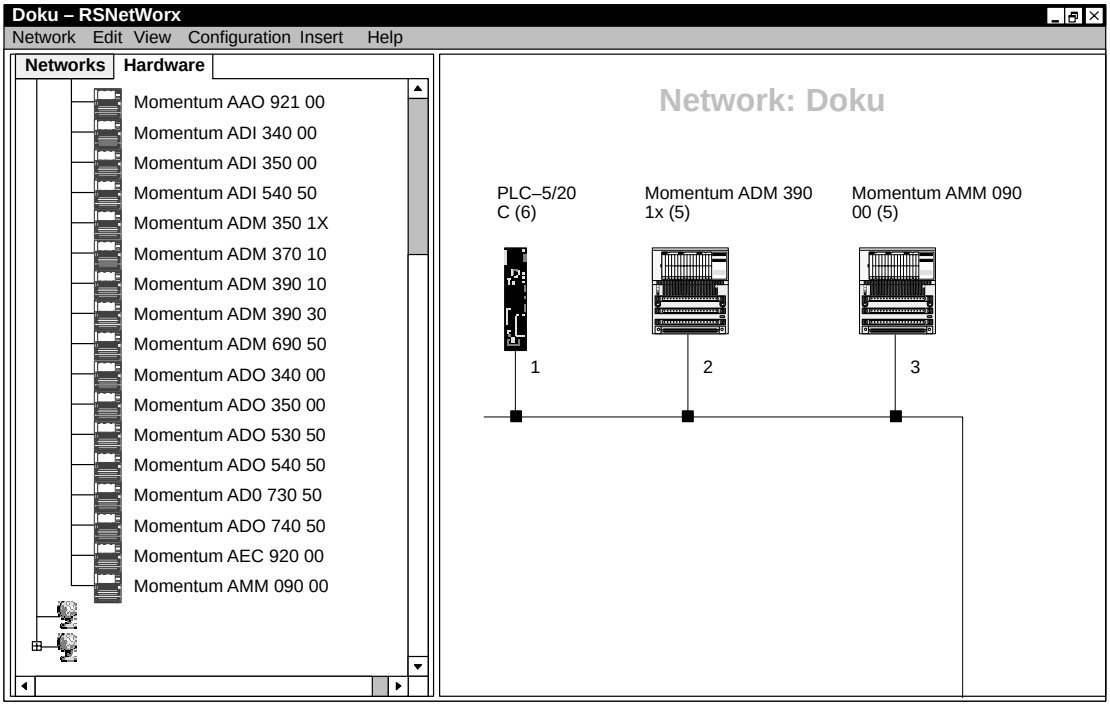
In the window `General` you can edit a name and a description for your Network and set the path to your configuration file (Off–line file) and to your PC–Card (On–line Path).



5.1.3 Network Configuration

You can configure your network both online and offline. The online configuration is described below.

1. Connect all devices to the network and ensure that they are wired properly
2. Power the modules and the PLC
3. Connect your PC to the network. Your configuration tool RSNetWorx is still running.
4. Go online by clicking on the On–line Box.
   You can find the online box in the tool bar. RS NetWorx will scan all connected devices. A grafic with the detected bus configuration occurs.



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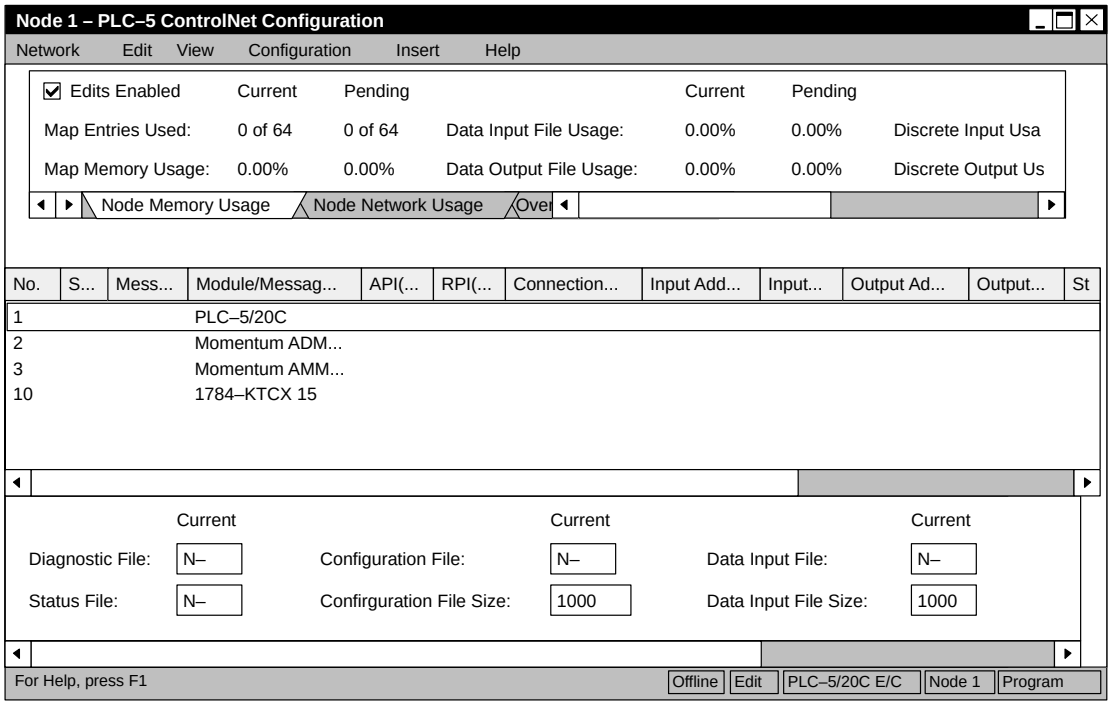
5. Double click the icon for the PLC with the right mouse botton. The following screen with the configuration list occurs:


Node 1 – PLC–5 ControlNet Configuration
Network Edit View Configuration Insert Help
Edits Enabled Current Pending Current Pending
Map Entries Used: 0 of 64 0 of 64 Data Input File Usage: 0.00% 0.00% Discrete Input Usa
Map Memory Usage: 0.00% 0.00% Data Output File Usage: 0.00% 0.00% Discrete Output Us
Node Memory Usage
Node Network Usage
No. S... Mess... Module/Messag... API(... RPI(... Connection... Input Add... Input... Output Ad... Output... St
1 PLC–5/20C
2 Momentum ADM...
3 Momentum AMM...
10 1784–KTCX 15
Current Current Current
Diagnostic File: N–
Configuration File: N–
Data Input File: N–
Status File: N–
Confirguration File Size: 1000
Data Input File Size: 1000
For Help, press F1
Offline
Edit
PLC–5/20C E/C
Node 1
Program

6. Click on the first line of the configuration list (entry for the PLC)

7. Select `Configuration` in the main menue an then `Auto Module` –> `All`.

The configuration is done now. Before saving the configuration we continue with the data mapping. Otherwise RSNetWorx would close the editor and we must enable the edit mode again.

5.1.4 Data mapping in the PLC

You can map the data both automatically or manually. The automatically mapping is described below.

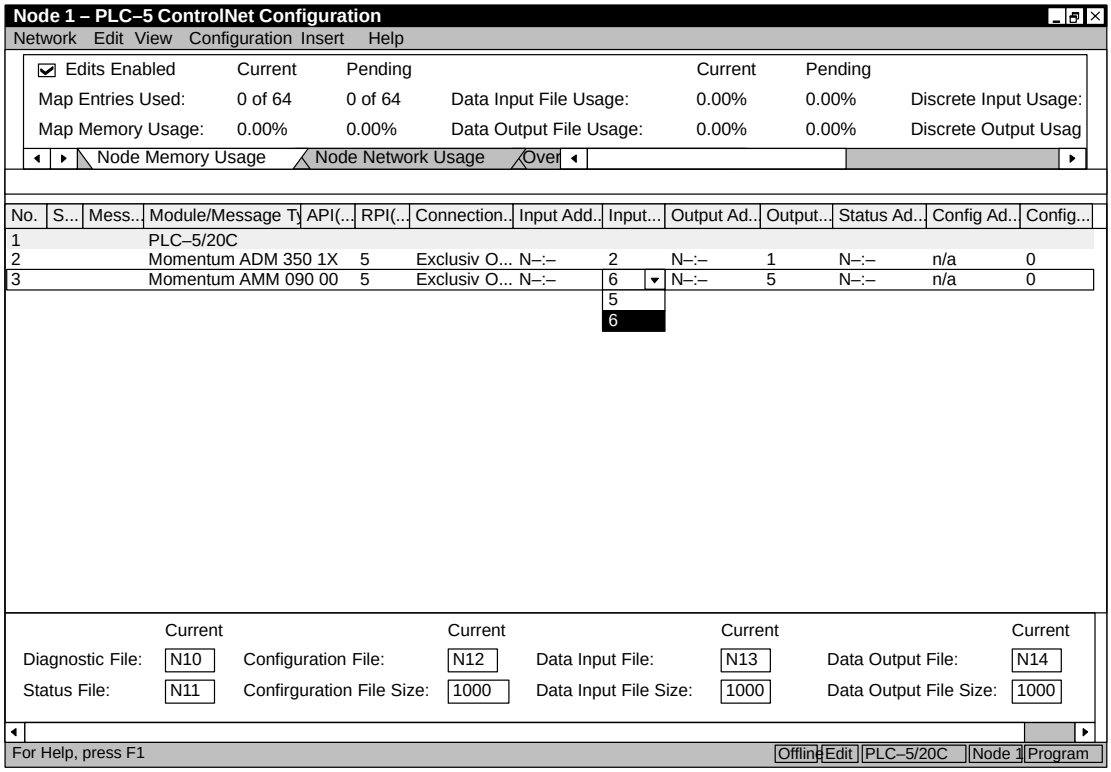
1. Select `Configuration` in the main menue an then `Auto Map` –> `All`.
2. Ensure that the relevant filenames are entered in all dialog boxes in the bottom of the screen.
3. Select `Network` in the main menue an then `Save` to save the configuration and mapping data.
4. Close the current window.

Alternatively to the steps above you can perform the manual data mapping as follows:

1. Select the module you want to map in the list of inserted modules by a click with left mouse button.
2. Select `Insert` in the main menue an then `Device Connection`.
3. Double click the field `Input` in the modules row.

Breite: 178 mm
Höhe: 216 mm

4. A dialog box opens with two values. Select the lower value when you don't want to transfer diagnostic information. Otherwise confirm the higher value (default).



5. Enter the address of the relevant data block to all fields with the entry `N–:–`

6. Enter the name of the relevant datafile to all fields with the entry `N–`

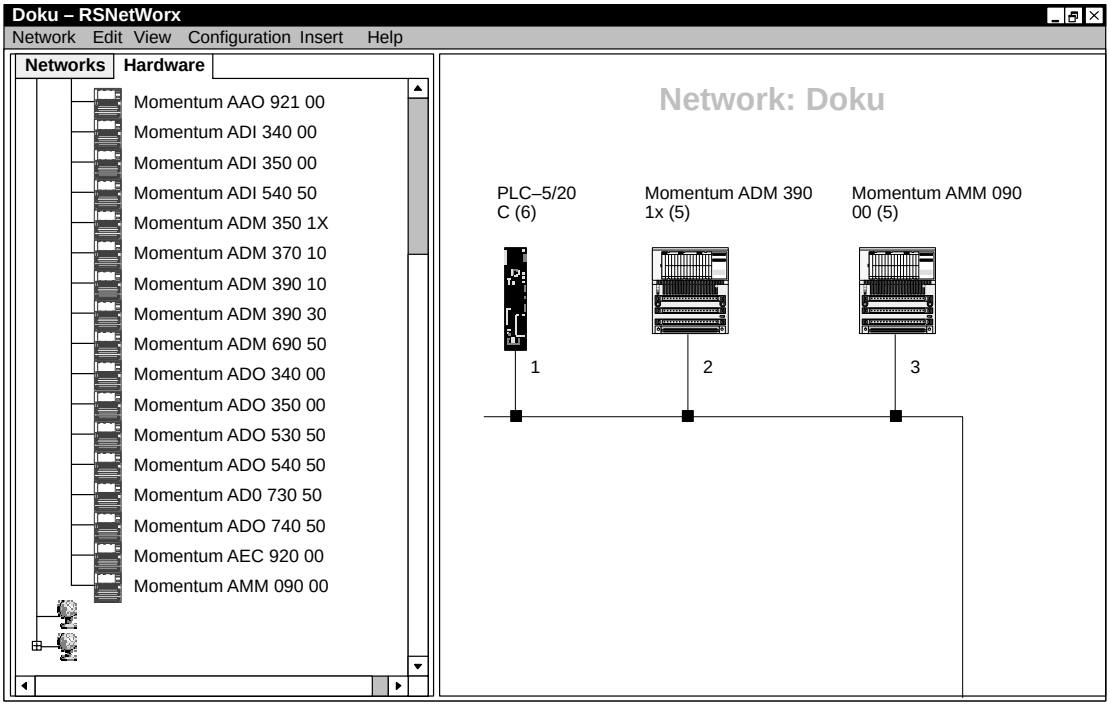
7. Select `Network` in the main menue an then `Save` to save the configuration and mapping data.

8. Close the current window.

5.1.5 Download of the Network configuration to the PLC

You are still on–line. Proceed as follows:

1. Select `Network` from the main menue an then `Actions` –> `Download Configuration` to start the download.



After the operation is finished you will receive a message at the botton of the screen.

Breite: 178 mm
Höhe: 216 mm

5.2 Limitations for Mapping Data

For the different types of PLC–5 there are different limitations concerning the mapping data:

Max. number of Mapping entries	64 for PLC–5/20C15 96 for PLC–5/40C15 128 for PLC–5/80C15
Max. size of input / output files	2000 words for PLC–5/20C15 3000 words for PLC–5/40C15 4000 words for PLC–5/80C15

☞ **Note**
These are the actual limitation given by Allen Bradley. They might change in future.